DOCUMENT RESUME

ED 116 153 CS 002 317

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TITLE	Evaluation Studies of the Pre-Reading Skills Program.
INSTITUTION	Wisconsin Univ., Madison. Research and Development Center for Cognitive Learning.
SPONS AGENCY	National Inst. of Education (DHEW), Washington, D.C.
REPORT NO	WRDCCL-TR-311
PUB DATE	75
CONTRACT	NE-C-00-0065
NOTE	53p.
EDRS PRICE	MF-$0.76 HC-$3.32 Plus Postage
DESCRIPTORS	*Beginning Reading; Primary Education; *Reading Programs; *Reading Readiness; Reading Research; *Reading Skills; Retention; *Retention Studies
IDENTIFIERS	*Prereading Skills Program

ABSTRACT

The Pre-reading Skills Program (PRS) was developed at the Wisconsin Research and Development Center for Cognitive Learning. Research on prereading skills was conducted from 1966 to 1969. The developmental period, 1970 to 1974, included piloting and field testing instructional materials, teachers' manuals, assessment instruments, and a management system. During 1972-73, a study was designed and carried out to investigate achievement associated with PRS. Taking part in the study were kindergarten children from (1) classes whose teachers were using PRS for the first time, (2) classes whose teachers had used PRS during the previous year, and (3) classes whose teachers were not using PRS; and first grade children who had not used PPS in kindergarten. The major result of the study was that kindergarten children who used PRS scored significantly higher on five prereading skills tests than children who did not use the program. The study also showed that there is a high percentage of retention of mastery or nonmastery status between the end of kindergarten and the beginning of first grade. (Author/TS)

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ED116153

Technical Report No. 311

EVALUATION STUDIES OF THE PRE-READING SKILLS PROGRAM

by

Richard L. Venezky, Michael Green, and Ronald Leslie

Report from the Project on
The Pre-reading Skills Program

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Wisconsin Research and Development
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Madison, Wisconsin
August 1975

CS 002 317

Published by the Wisconsin Research and Development Center for Cognitive Learning, supported in part as a research and development center by funds from the National Institute of Education, Department of Health, Education, and Welfare. The opinions expressed herein do not necessarily reflect the position or policy of the National Institute of Education and no official endorsement by that agency should be inferred.

Center Contract No. NE-C-00-3-0065

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CENTER FOR COGNITIVE LEARNING

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- developing improved instructional strategies, processes and materials for school administrators, teachers, and children, and
- offering assistance to educators and citizens which will help transfer the outcomes of research and development into practice

PROGRAM

The activities of the Wisconsin R&D Center are organized around one unifying theme, Individually Guided Education.

FUNDING

The Wisconsin R&D Center is supported with funds from the National Institute of Education; the Bureau of Education for the Handicapped, U.S. Office of Education; and the University of Wisconsin.

ACKNOWLEDGMENTS

The studies reported here were carried out by the entire staff of the Pre-reading Skills Project. Special mention, however, should be made of Susan Pittelman, who coordinated the study; Susan Chicone, who supervised the testing; and Marga Kamm, who assisted in drafting the initial sections of this report.

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ABSTRACT

The Pre-reading Skills Program (PRS) was developed at the Wisconsin Research and Development Center for Cognitive Learning. Research on prereading skills was conducted from 1966 to 1969. The developmental period, 1970 to 1974, included piloting and field testing instructional materials, teachers' manuals, assessment instruments, and a management system.

During 1972-73, a study was designed and carried out to investigate achievement associated with PRS. Taking part in the study were kindergarten children from (1) classes whose teachers were using PRS for the first time, (2) classes whose teachers had used PRS during the previous year, and (3) classes whose teachers were not using PRS; and first grade children who had not used PRS in kindergarten.

The major result of the study was that kindergarten children who used PRS scored significantly higher ($\alpha = .01$) on five prereading skills tests than children who did not use the program. The study also showed that there is a high percentage of retention of mastery or nonmastery status between the end of kindergarten and the beginning of first grade.

I

INTRODUCTION

The Pre-reading Skills Program (PRS), a complete kindergarten level program designed to prepare children for reading instruction, was developed at the Wisconsin Research and Development Center for Cognitive Learning over the period 1970-74. It is now produced commercially by the Encyclopaedia Britannica Educational Corporation and, as of November 1974, was being used in approximately 500 classrooms. This paper reports studies done during 1972 and 1973 which investigated the effectiveness of PRS in meeting its skill objectives, the retention of the prereading skills between kindergarten and first grade, and the mastery of prereading skills after the first year of reading instruction. These investigations utilized a field test version of PRS and are part of a continuing program for the empirical validation of PRS and its materials.

II

PROGRAM DESCRIPTION AND HISTORY

The goals of PRS are (1) to accustom children to a reading environment so that they feel comfortable with reading instruction; (2) to ensure that children acquire a positive attitude toward reading; and (3) to teach children five specific prereading skills--attending to letter order, attending to letter orientation, attending to word detail, sound matching, and sound blending. These five skills were identified in earlier studies (Venezky & Chapman, 1970) as being prerequisites for success in beginning reading. The rationale behind PRS is that reading failure can be prevented by ensuring that children have these experiences, attitudes, and skills before they begin formal reading instruction.

From 1966 to 1969 research was conducted on prereading skills that were potentially related to reading success, and on the development of letter-sound generalizations at the primary level. In an exploratory and speculative paper, Venezky, Calfee, and Chapman (1968) discussed relationships between reading, initial reading problems, and reading skill components. That paper was followed by a more technical discussion of reading skills (Calfee & Venezky, 1968), which analyzed the importance of the reading skills identified in contemporary reading research and the assessment of reading skills by standardized reading tests.

Initial studies of specific prereading skills were reported by Calfee, Chapman, and Venezky (1970). The major results of this research were the isolation of certain skills that related both logically and statistically to beginning reading--such as letter-string matching and sound matching--and the isolation of other skills that were found to have little or no relation to reading success--such as phonemic discrimination and articulation.

Concurrent with these studies on prereading skills, development of an instrument for assessing skill abilities was begun. Chapman (1971a, 1971b) reported the early development, administration, and refinement of a battery of prereading skills tests. Originally called the Wisconsin Basic Prereading Skill Test, this instrument became the basis for the set of criterion-referenced tests that are used for skill assessment in the current program. By 1970, sufficient evidence was accumulated to suggest that not only is it possible to diagnose prereading skill deficiencies at the kindergarten level, but also that remedying these deficiencies in kindergarten could significantly reduce reading failure during the first year of reading instruction. Plans were therefore drafted to begin development of an instructional program in prereading skills that would focus on basic visual and auditory skills. These plans culminated in a needs and specifications paper which outlined an instructional program in prereading skills (Venezky & Chapman, 1970). One concern of that paper was the selection of skills for the envisioned kindergarten program. A skill had to meet two criteria before it would be considered

for emphasis in the program. First, the skill had to have a direct, logical relationship to learning to read or to the reading process; and second, it had to show a high partial correlation with reading success.

During the fall of 1970, five prereading skills were selected to be taught in the program. These were skills that were not only logically related to learning to read, but also had been found lacking in a sufficient number of kindergarten children to warrant their inclusion in a program. The five skills that were selected in 1970 are the ones that form the basis of the current program.

Various instructional activities to teach these visual and auditory skills were developed and tried out with groups of kindergarten children during the fall of 1970. At the same time, the Wisconsin Basic Prereading Skill Test was revised and field tested on kindergarten children in Madison, Wisconsin. On the basis of that testing, the battery was further revised, and another sample of responses was obtained in the winter of 1970.

A teacher's manual was then prepared, containing activity descriptions, scheduling suggestions, and guidelines for assessment. This manual, together with the instructional activities that had been developed, formed the prototype of PRS.

From February to May of 1971 this prototype was used in three Madison kindergartens. A staff member from the Wisconsin Research and Development Center was present at each class session to serve as an aide and to evaluate the activities. Children's skill learning was also evaluated by administering the Wisconsin Basis Prereading Skills Test.* At the end of the semester, the prototypic program was evaluated both in terms of children's skill learning and in terms of the teachers' response to the instructional activities. Results of the tryout, reported in Venezky, Chapman, Seegal, Kamm, and Leslie (1971), justified plans to expand the program to a full school year of instruction.

During the summer of 1971, a program to teach the five skills was completed. The instructional procedures adopted were based on the R & D Center's model of Individually Guided Education (IGE), and featured a variety of instructional groupings, with emphasis on small group and individual activities. The program included day-by-day sequences of instructional activities to teach the five skills, materials for these activities, and a management system featuring edge-notched cards to help the teacher keep records of each child's needs and progress. The program also included a teacher's handbook, a resource file containing activity descriptions, and a revised version of the Wisconsin Basic Prereading Skills Test.

In the 1971-72 school year, 14 teachers in 10 Wisconsin and Illinois schools participated in a field test of the program. In total, there were 23 kindergarten classes, including 545 children. The 10 schools included both conventional schools and schools implementing the IGE system and, within these categories, both urban and nonurban settings. The field test design provided for formal (summative) evaluation of the Pre-reading Skills Program in terms of children's learning of the five prereading skills, and

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*At this point the test was renamed from Wisconsin Basic Prereading Skill Test to Wisconsin Basic Prereading Skills Test.

for subjective (formative) evaluation in terms of usability and effectiveness of the program activities and materials. The formal evaluation was carried out by the R & D Center's evaluation section, while informal evaluation was done by the Pre-reading Skills Project staff. Schools were closely monitored to determine the effectiveness of each component of the program, and feedback sessions with teachers were held to review the various program activities and materials.

The field test results, which were documented by Kamm, Zajano, Hubbard, and Pittelman (1973), confirmed that teachers could successfully implement an individualized program to teach prereading skills. It was therefore decided to retain the overall design of the Pre-reading Skills Program in the next version of the materials. The field test also indicated that some revisions were necessary to shorten the instructional program, to clarify activity descriptions, and to facilitate the use of the classroom management system. The Prereading Skills Test,* which is the formal assessment instrument of the program, needed additional development, as did the inservice training to prepare teachers to use the program.

A small scale field test of the revised Pre-reading Skills Program was held during the 1972-73 school year. This field test included schools that had used the program during the 1971-72 school year as well as several additional schools. Two separate studies were conducted during this field test. One, a detailed investigation of the effectiveness of PRS in meeting its objectives and of skill retention between kindergarten and first grade, is reported in the next chapter of this paper. The other study investigated inservice techniques for helping teachers utilize PRS and also used classroom observation and teacher-feedback sessions to obtain information about the revised materials and to determine whether any further revisions of the instructional program would be needed. The results of this field test, which are reported by Kamm and Pittelman (1975), indicated that the revisions made in the program were effective but that further refinements of selected materials were desirable.

In 1973, the National Institute of Education approved plans for publication, and a contract was signed between the Board of Regents of the University of Wisconsin and Encyclopaedia Britannica Educational Corporation to publish the program under the name PRS. The program was published in August 1974, and was nationally available for the 1974-75 school year.

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*At this point the test was again renamed.

III

EVALUATIONS

INTRODUCTION

PRS, the Pre-reading Skills Program, is based on the hypothesis that children who master the skills stressed by the program are ready for formal reading instruction. Analysis of how to validate this hypothesis exposed several hidden questions that had to be answered before the hypothesis could be investigated. Before describing the effects of PRS on children's preparation for reading, it first had to be determined whether kindergarten children could in fact master the skills. Also, it had to be ascertained whether mastery could be attributed to the program, or to maturity, or whether children entered kindergarten with the skills. It was also necessary to know whether the skills were retained once they were learned.

Some of these questions had been investigated early in the development of PRS because the selection of skills involved decisions about what needed to be taught and what could be taught. More formally, data from the 1971-72 field test established first that kindergarten students who participated in the field test did not come to school with mastery of the five prereading skills, and second that a substantial increase in the students' mastery of the prereading skills occurred by the end of the kindergarten year in the classes where PRS was used (Kamm et al., 1973). However, conclusions about the effectiveness of PRS cannot be drawn from these data alone, chiefly because no estimates of expected levels of skill mastery were obtained for students not using the program. In addition, although data were gathered on reading failure among program students who had completed their first year of formal reading instruction, interpretation of these data was limited by the groupings of the first grade classes. Some of the first grade classes were mixed--they contained some children with program background and some with nonprogram background. Also, there was not enough information available on whether first grade teachers changed their curriculum scheduling to take advantage of the increased readiness for reading of the entering students. Finally, no investigation had been made of the degree to which prereading skills mastered in kindergarten are retained until the next school year. The primary and the hidden questions dealing with the central hypothesis for the program had not been sufficiently studied.

Thus a study was designed to investigate the following specific questions:

1. What effect does PRS have on skill mastery?
2. What changes in skill mastery occur over the summer between kindergarten and first grade?
3. Are the PRS skills mastered by the end of the first year of reading instruction by children who did not have PRS in kindergarten?

The first question seems deceptively simple, in that it might be answered quite quickly by measuring skill mastery gains for PRS classrooms. However, this approach would fail to separate natural or spontaneous gain from program-related gain. It is not easy to determine exactly how to measure the effect in an unbiased manner; this problem is one of the central issues of evaluation studies. The traditional approach, which is to compare program with nonprogram groups, has a number of faults, the most important of which is the difficulty of defining in precise terms the nonprogram or control group. To compare classrooms on the basis of the formal programs which the teachers claim to be implementing is of little value, since most kindergarten-level instruction is teacher-centered and loosely structured, leaving considerable latitude for the teacher to deviate from the intentions of the program authors. In addition, most kindergarten-level programs are not specific about activity sequencing or about skill mastery. In classrooms which do not use published prereading programs teachers still tend to give prereading instruction, as, for example, in letter-name drills or rhyming activities. Unless lengthy (and expensive) observation schemes are adopted, the amount of prereading instruction given by a kindergarten teacher cannot be accurately estimated.

Nevertheless, after alternatives to the control-group approach that could be executed in a single year were considered, a decision to employ the control-group approach was made, based upon the following factors:

1. The specific activities of PRS teachers are specified in the program schedule and resource file cards. Techniques had already been developed for determining how closely the teachers followed the schedule and resource file cards and how much time they spent in PRS activities.
2. Since the control groups were used primarily to estimate the natural or spontaneous growth in skill mastery during the kindergarten year, classes which did not emphasize prereading skills could be used, even without having precise estimates of the time spent and techniques used for prereading skill instruction.
3. Major deviations from the conditions in 2 above would diminish the program effects, and hence the study would give a conservative estimate of the efficiency of the program, rather than the positively biased one that is usually associated with control-group comparisons.

Rather than representing the case for natural or spontaneous growth of certain skills, the control groups in this study actually reflect varying (and undetermined) amounts of direct instruction in these skills. Since the child's presence in a kindergarten may have a positive influence on his acquisition of a variety of specific skills, nonkindergarten children were not included in the study. Attempts to control or to assess directly the amount of prereading skill instruction in the control classes were ruled out, either because they would have been excessively expensive or because they would have created an unnatural classroom situation.

To reduce certain other biases inherent in control-group studies, two types of comparisons were made, one based on skill mastery as measured by

the PRS tests, and the other based on total scores obtained on a standardized reading readiness test.

The second question investigated, that of skill retention between kindergarten and first grade, requires comparisons of mastery levels before and after the summer vacation, and is, for the most part, free of the uncertainties that applied to the other question.

The third question, that of mastery of prereading skills at the end of the first year of reading instruction, touches on an issue that is not explored in depth here, namely, how do we determine that the PRS skills are necessary and sufficient for learning to read? A discussion of this issue is presented by Venezky (1975). For the present we are attempting to determine only if the skills which are considered essential for entering into reading instruction are in fact acquired by the end of the first year of reading instruction. Admittedly, this is a weak test of necessary and sufficient conditions, but it was the only one we were willing to undertake using the field test version of the program.

PROCEDURE

Several groups of children were identified for the study: kindergarten children whose teachers were using the program for the first time (Program I); kindergarten children whose teachers had used the program in the previous year in addition to the current year and were therefore familiar with its goals and materials (Program II); kindergarten children in classes that were not using the program and whose schools had been identified as being comparable to the Program I schools by the R & D Center's Evaluation Section (Control); and first grade children in Program I and Control schools who had no kindergarten experience in the program (Grade 1).

The two program groups were differentiated in order to assess the effects of teacher experience or familiarity on children's achievement. The first grade group was included primarily to identify the levels of prereading skill mastery at the beginning and at the end of the first year of formal reading instruction.

Both urban and nonurban schools were selected for Program I and Control groups, to ensure that the sample of students included a wide range of experience and ability. All of the schools designated as Program II were in cities with populations of less than 200,000.

The resulting sample included 43 classes. The kindergarten group contained seven Program I classes (164 children), 12 Program II classes (199 children), and 14 Control classes (264 children). Part of the imbalance among the kindergarten groups is because one of the Program I schools did not use PRS after completing the initial fall testing. Since the fall session had started, this school was not replaced; instead the classes were made part of the Control group. In the first grade group, there were 10 classes comprised of 257 children.

Four children--two boys and two girls--were selected randomly from each kindergarten and first grade class for testing with the Prereading Skills Test. Testing was done individually by Center personnel. The testing

schedule was designed to give both comparative and longitudinal data. Children from the three kindergarten populations were tested at the beginning and end of kindergarten in the 1972-73 school year and also at the beginning of first grade the following year. The children in the Control group were tested additionally during the winter of their kindergarten year to ensure that they received the same exposure to the tests as the Program I and Program II children whose teachers used the test as part of their instructional program. The first grade children were tested at the beginning and end of the 1972-73 school year. Since the blending test was being revised when the study began, it was not included in the first fall or the winter testing sessions at either grade level. The Clymer-Barrett Test of Reading Readiness was given to all the kindergarten children at the end of their kindergarten year. Table 1 summarizes the testing schedule as described above, presents the number of schools and children in each group and in the sample, and indicates the rates of attrition.

TABLE 1

Number of Children Who Took the Prereading Skills Test in Each Group During the 1972-73 Longitudinal Study

	Fall 1972	Winter 1972-73	Spring 1973*	Fall 1973*
Program I 4 schools 7 classes 164 children	26	--	22	15
Program II 5 schools 12 classes 199 children	48	--	36	27
Control 4 schools 14 classes 264 children	56	51	46	26
Grade 1 5 schools 10 classes 257 children	40	--	37	--

*Includes the Sound Blending Test.

RESULTS I--EFFECTS OF PRS ON SKILL MASTERY

Each subject was classed as either a master or a nonmaster on each test. (Mastery required a minimum of 14 correct out of a total possible score of 16.) The resulting scores, which are summarized in Table 2, show that the Control group was superior to the Program I group on three of the four fall tests and superior to the Program II group on two tests. By the end of kindergarten, however, the Control group was dramatically lower than either program group on all of the skills tested.

TABLE 2

Percentages of Kindergarten Children Mastering Each Skill

	N	Letter Order	Letter Orientation	Word Detail	Sound Matching	Sound Blending
Fall 1972						
Program I	22	5	14	9	5	*
Program II	36	17	42	8	6	*
Control	46	13	24	9	13	*
All Ss	104	11	24	8	8	*
Winter 1972-73						
Control	46	22	46	24	33	*
Spring 1973						
Program I	22	91	82	55	59	55
Program II	36	94	94	81	86	67
Control	46	44	64	33	31	24

*The Sound Blending test was not used in the fall or winter.

To compare score distributions, frequency distributions were plotted of the number of subjects obtaining each possible score on each test. These are shown in Figures 1-8. Each test was composed of multiple choice items, with three alternatives per item. Hence the guessing rate would be between five and six correct. For the fall and winter test sessions, the scores tend to be normally distributed with little evidence of either bottom or ceiling effects.

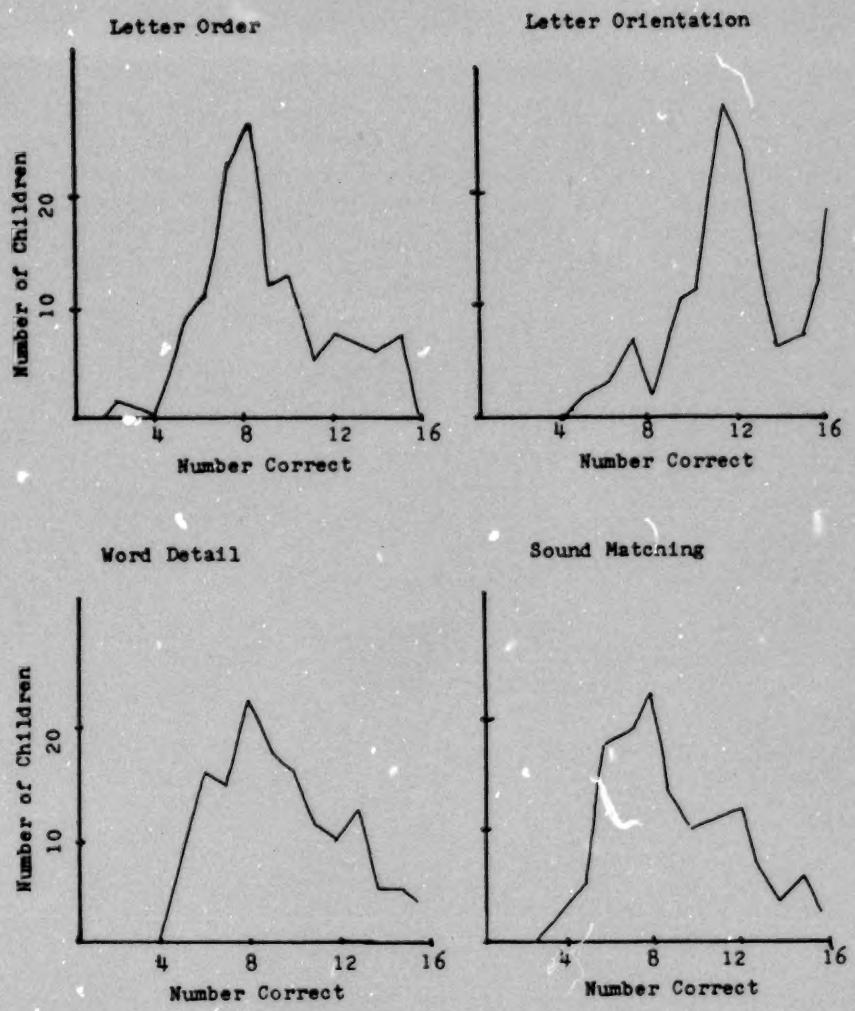


Figure 1. Frequency distributions of the number of children at each number of items correct--fall 1972, entire kindergarten group.

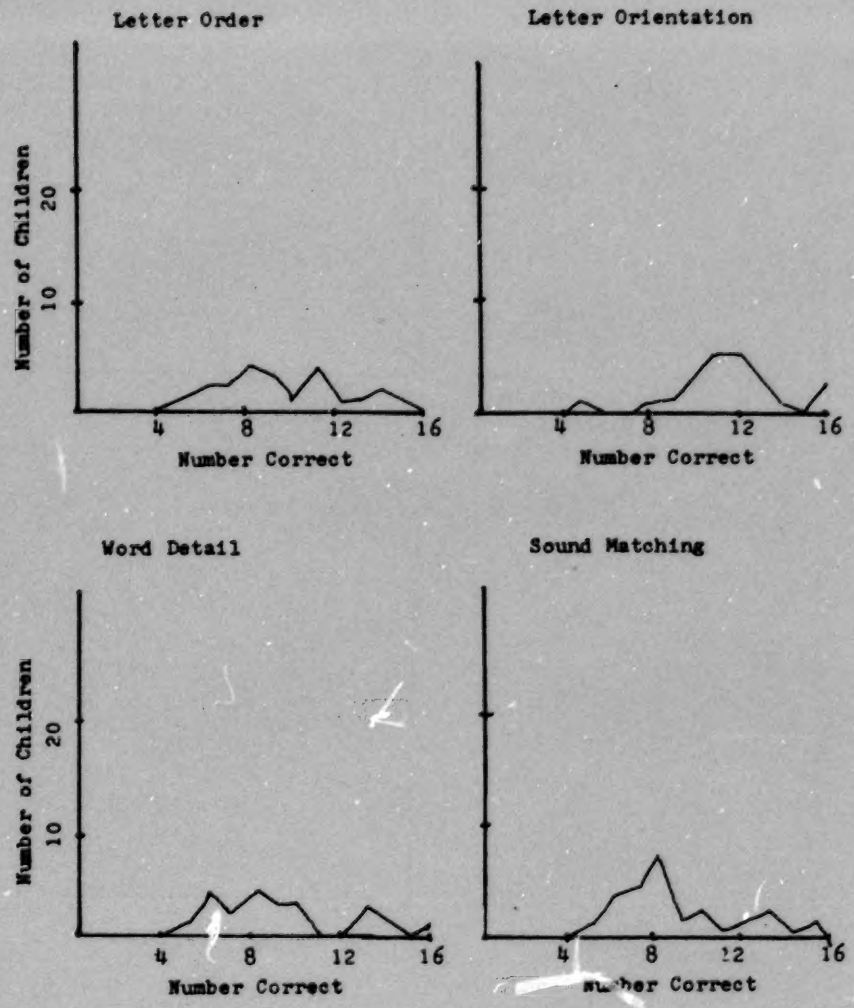


Figure 2. Frequency distributions of the number of children at each number of items correct--fall 1972, Program I group.

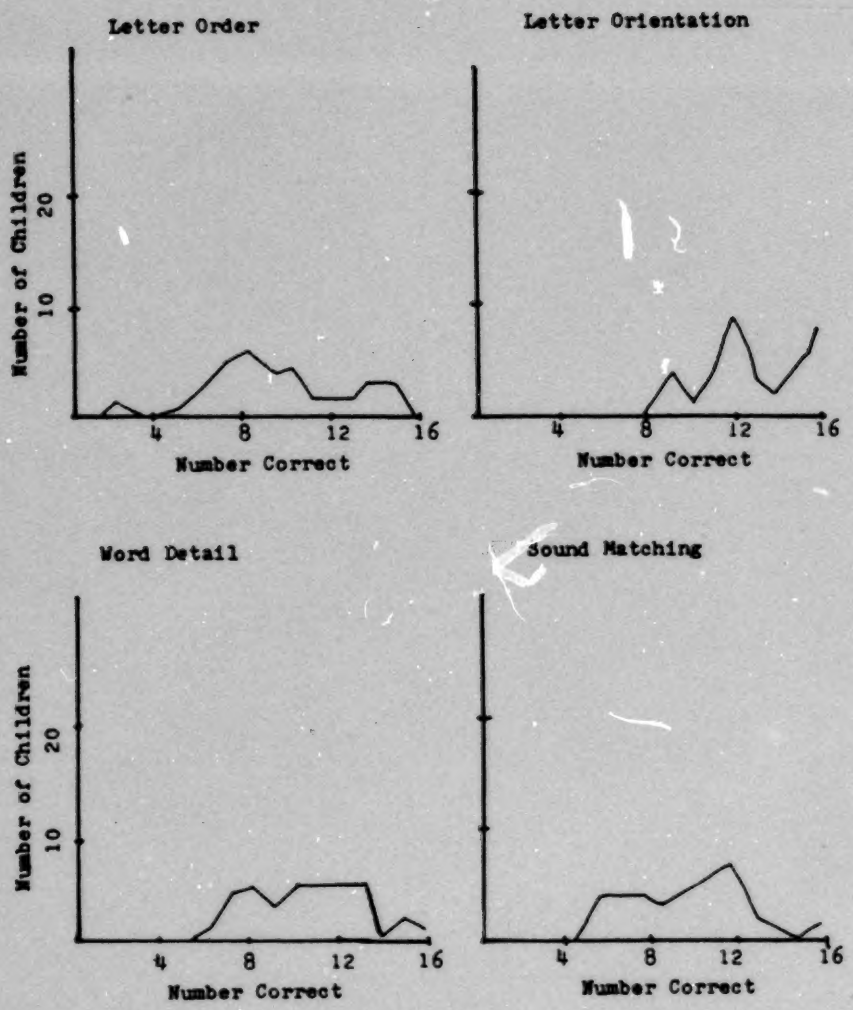


Figure 3. Frequency distributions of the number of children at each number of items correct--fall 1972, Program II group.

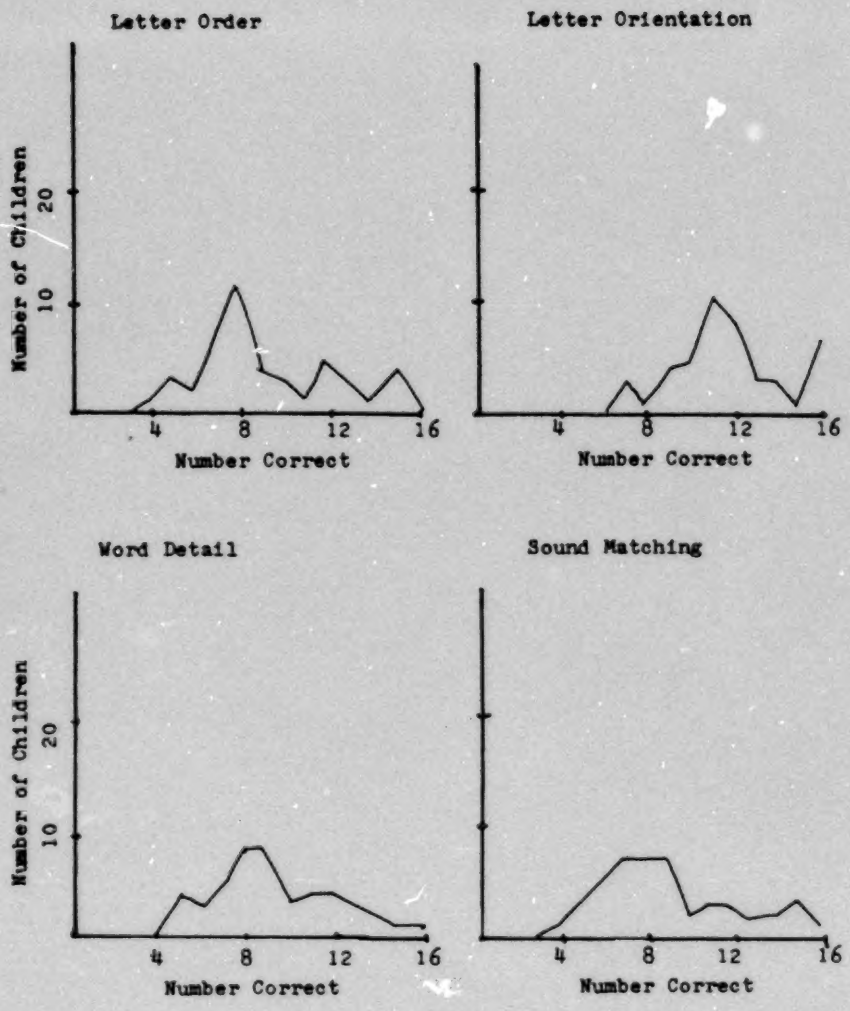


Figure 4. Frequency distributions of the number of children at each number of items correct--fall 1972, Control group.

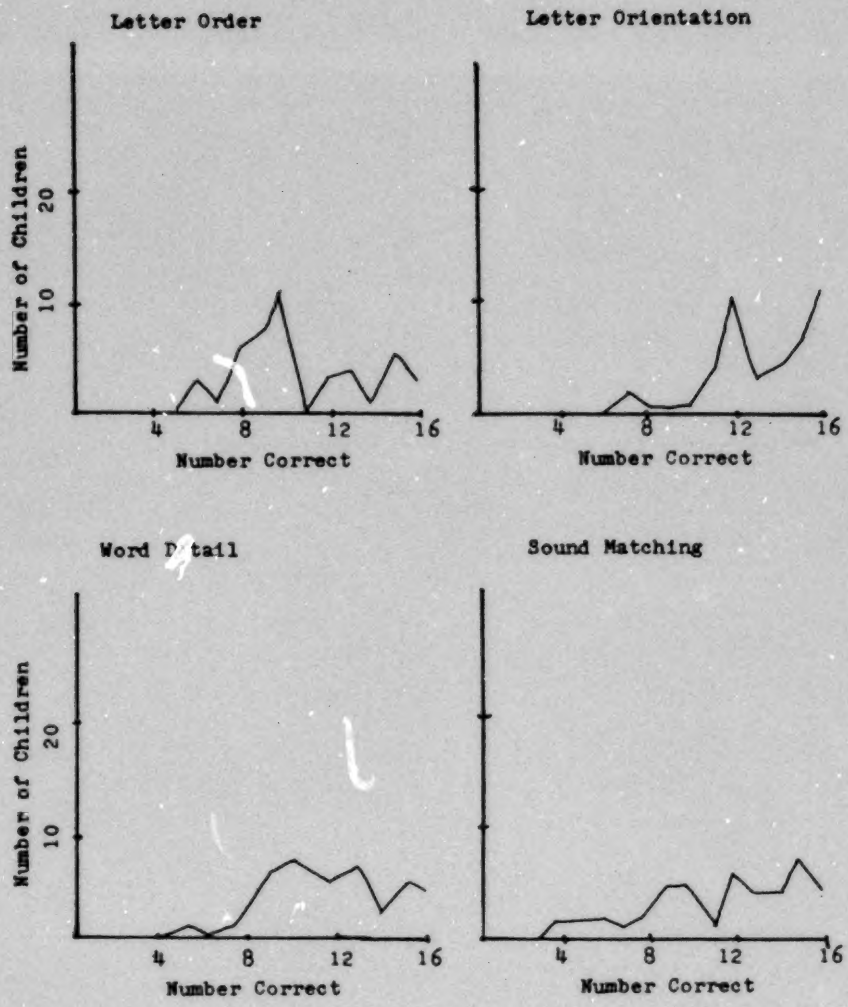


Figure 5. Frequency distributions of the number of children at each number of items correct--winter 1972-73, Control group.

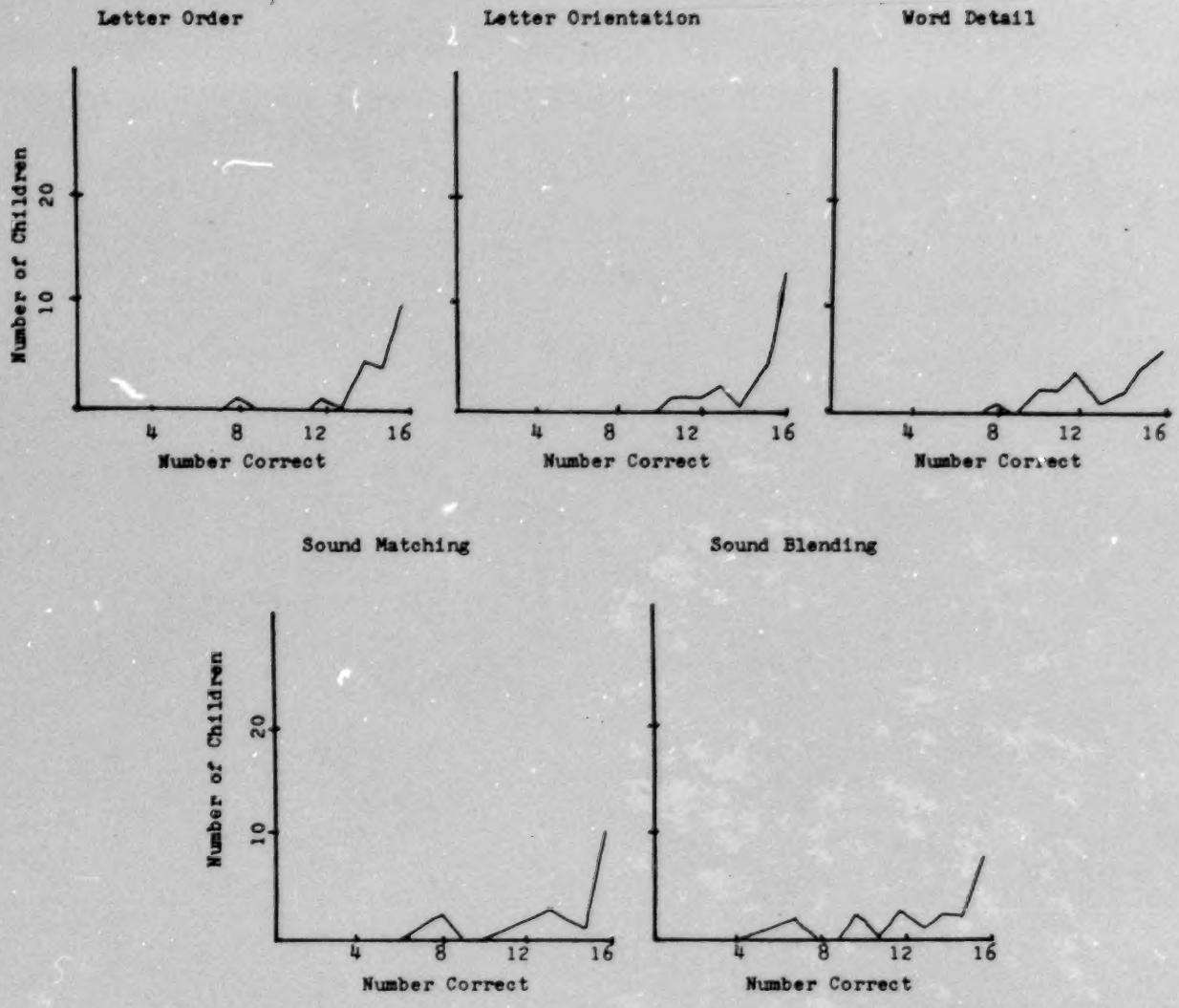


Figure 6. Frequency distributions of the number of children at each number of items correct--spring 1973, Program I group.

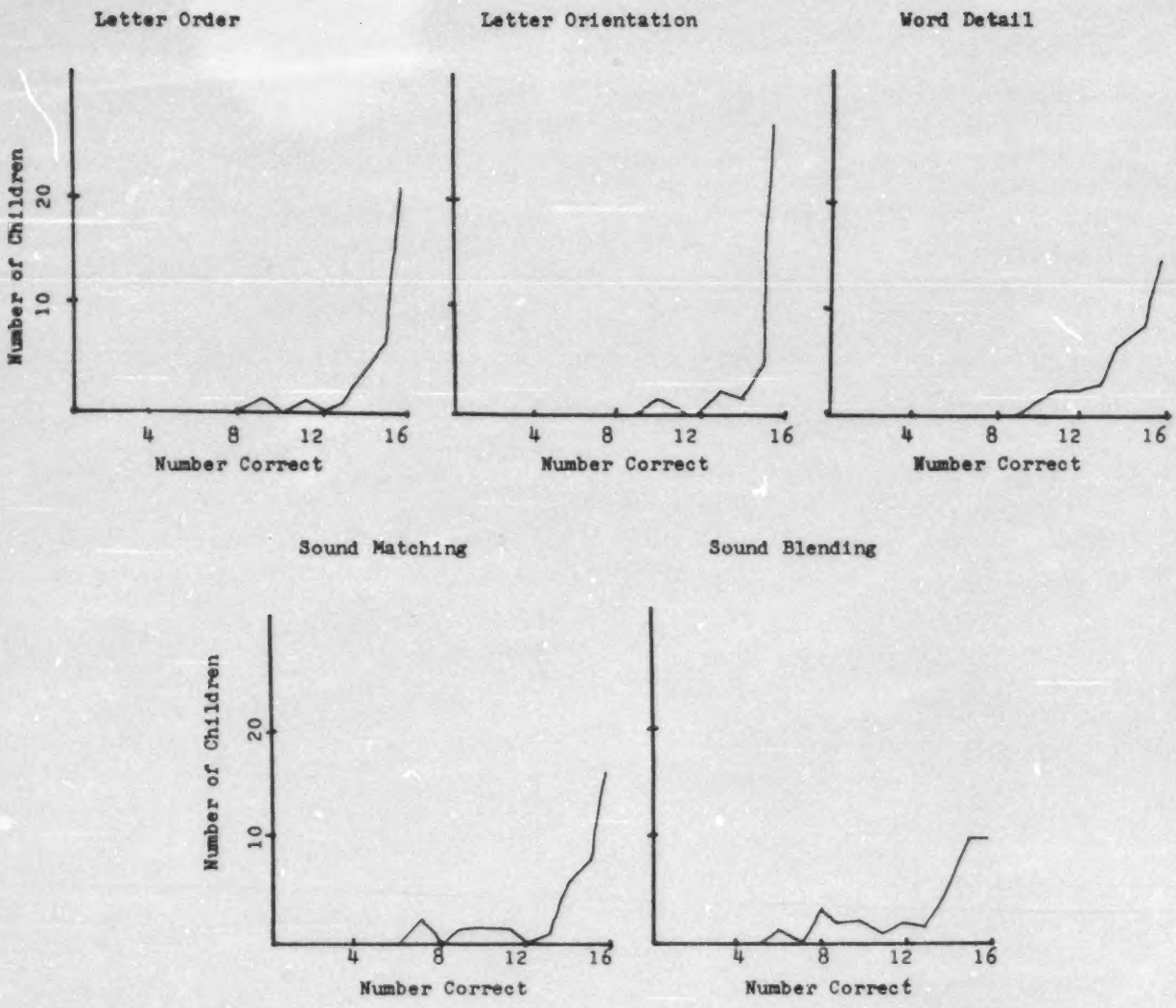


Figure 7. Frequency distributions of the number of children at each number of items correct--spring 1973, Program II group.

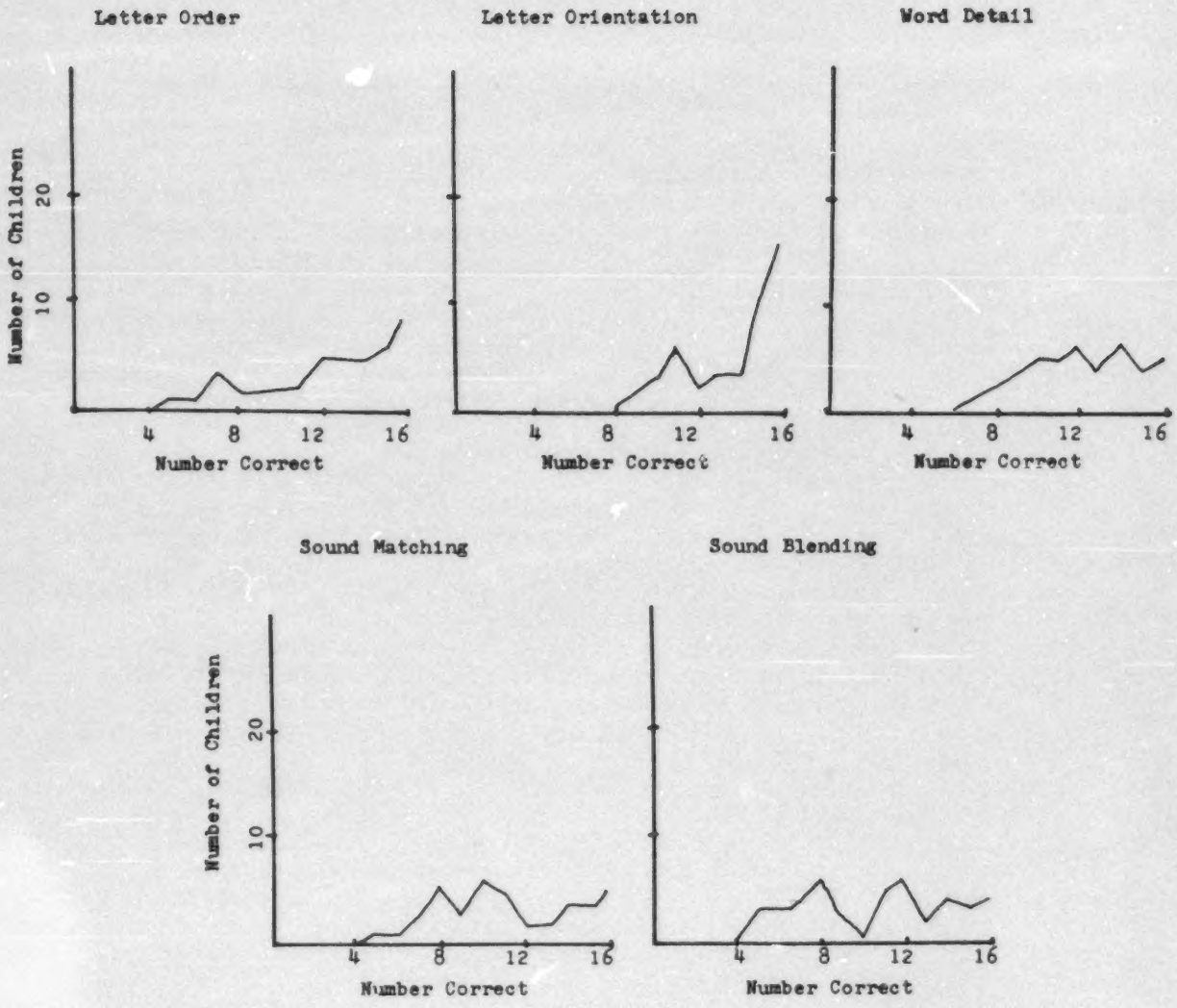


Figure 8. Frequency distributions of the number of children at each number of items correct--spring 1973, Control group.

For the spring testing session, Program I and Program II scores all clustered at the high end of the scale. Control group score distributions tended to flatten out in the spring, with a slight tendency toward bimodal distributions, especially for letter order and letter orientation.

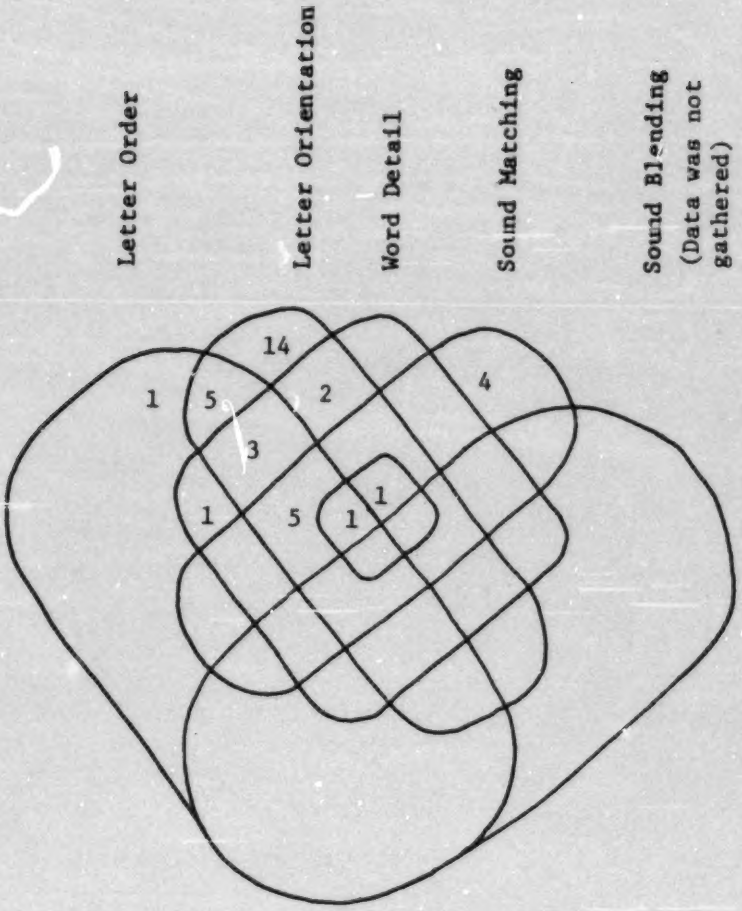
The combinations of skills that were mastered by children in both Program and Control groups are presented in Figures 9-16. Figure 12 indicates that, of the Control children who entered kindergarten with some of the skills, most (10 out of 14 or 71 percent) had mastered letter orientation. At the end of kindergarten (Figure 16) this is even more pronounced with 30 out of 33 or 91 percent of the children who had mastered at least one skill mastering letter orientation. The combination of letter order and letter orientation was the most frequently occurring combination; mastery was reached by two-thirds of the children in the spring 1973 Control group (Figure 16) who mastered skills. Figures 10 and 11 indicate that most of the Program I and II children who entered kindergarten with at least one of these skills had mastered letter orientation. At the end of kindergarten, nearly all of the children in the samples had mastered letter orientation and letter order (Figures 14 and 15). Other year-end combinations of skills are not clear, for different reasons; in the Program I sample, at least one-third of the sample failed to master each of the other three skills, while in the Program II sample over half the children mastered all five skills.

One of the principal questions of the study concerns the mastery levels of the prereading skills that may be expected from the use of the Pre-reading Skills Program; that is, the effectiveness of PRS in developing the skills in children. Data from the Program I, Program II, and Control groups were used to investigate this question.

Two initial problems had to be resolved when considering how to compare PRS users and nonusers: attrition from the three groups during the school year, which may have affected the samples differentially, and initial differences between the groups, which prevented simple year-end comparisons between users and nonusers.

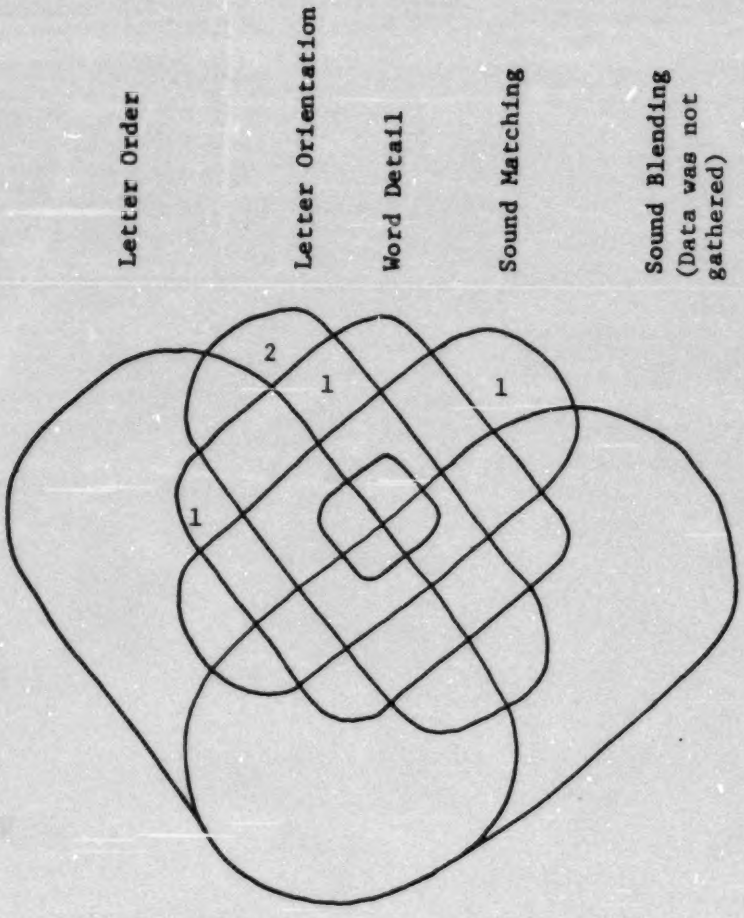
The question about attrition was, in effect, whether the children who took part in the treatment adequately represented the entire sample that had been identified at the beginning of the year. Investigation of this involved comparing the fall 1972 data for the Program I, Program II, and Control groups with the fall 1972 data for each respective subgroup. These comparisons are presented in Table 3. Of the differences between the percentages of children in samples and subsamples who mastered each skill, none is greater than 4 percent. This suggests that each subsample adequately represented its respective sample. Thus the groups of children who took part in the study were representative of the original random samples, and attrition during the school year was not a confounding factor.

The effectiveness of PRS was investigated by comparing data from users and nonusers of the program after attempting to take into account the apparent initial differences in the fall 1972 data. Two kinds of comparisons were studied. The first was a comparison of the means of users against nonusers on the various parts of the skills test. Another kind of comparison, which considered the mastery-learning aspect of the skills test, looked at group means of the number of skills mastered for users against nonusers.



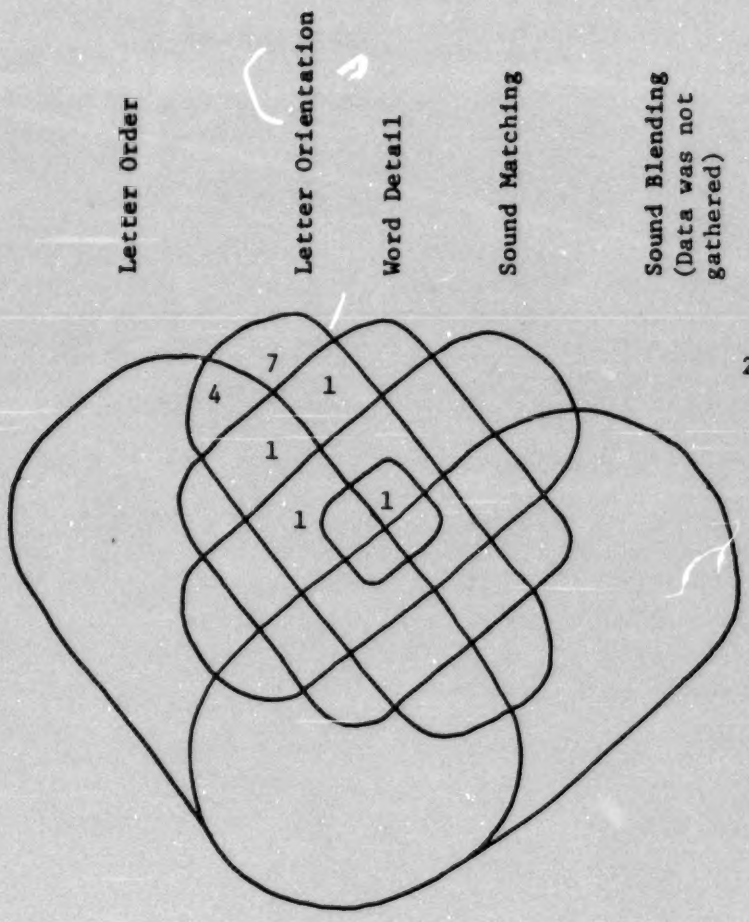
(Note: The small region in the center is to be taken as "outside" of the Word Detail region.)

Figure 9. The number of children mastering each combination of prereading skills--fall 1972, entire kindergarten group.



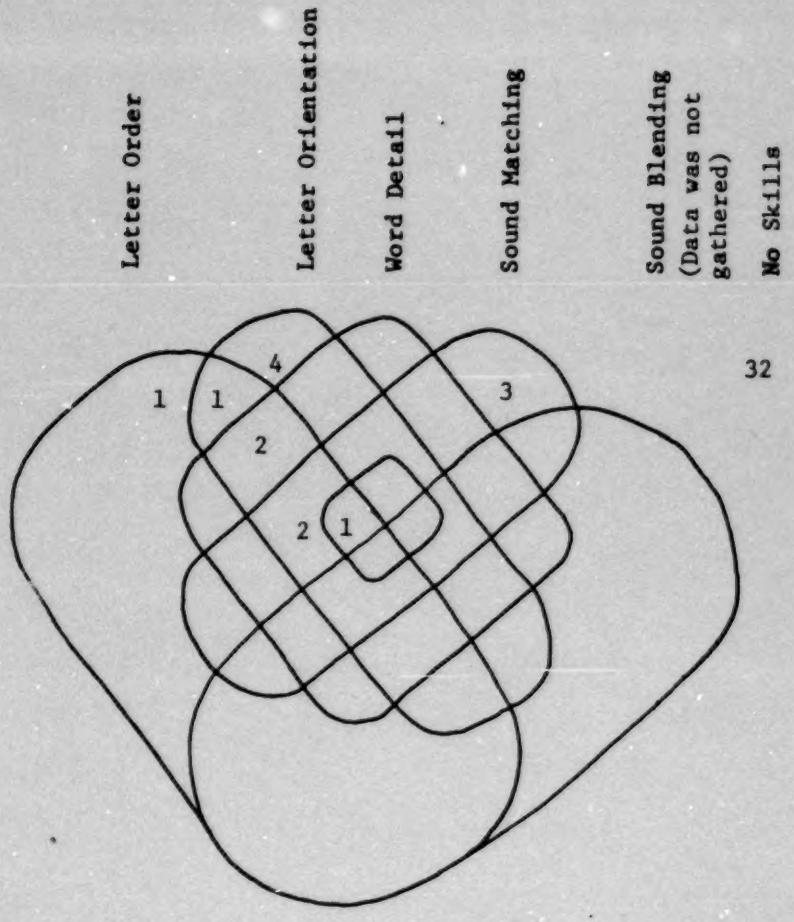
(Note: The small region in the center is to be taken as "outside" of the Word Detail region.)

Figure 10. The number of children mastering each combination of prereading skills--fall 1972, Program I group.



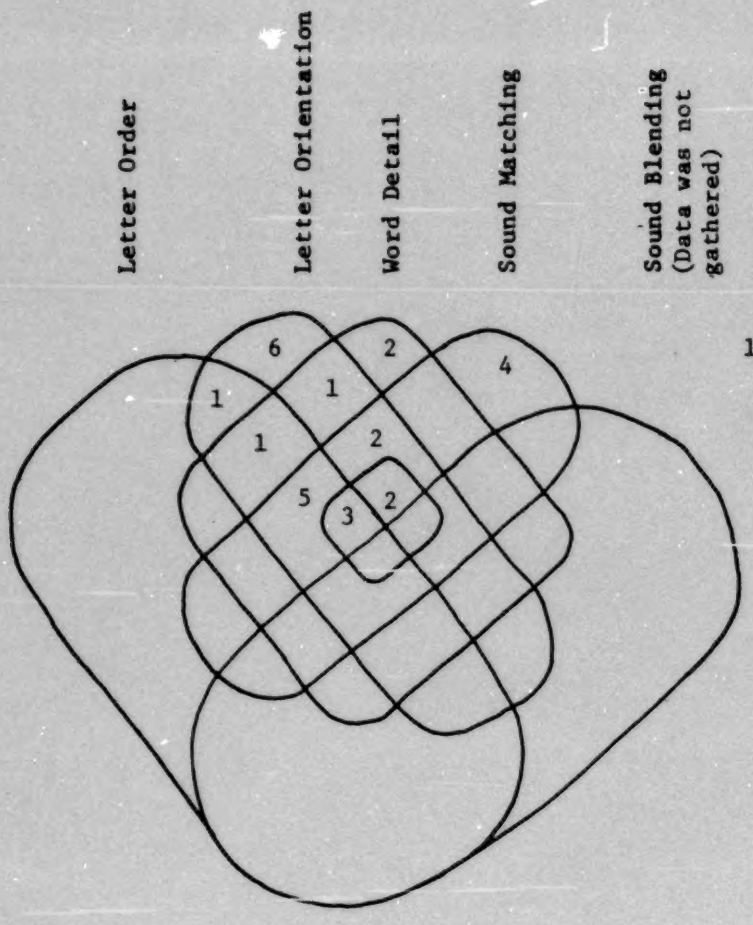
(Note: The small region in the center is to be taken as "outside" of the Word Detail region.)

Figure 11. The number of children mastering each combination of prereading skills--fall 1972, Program II group.



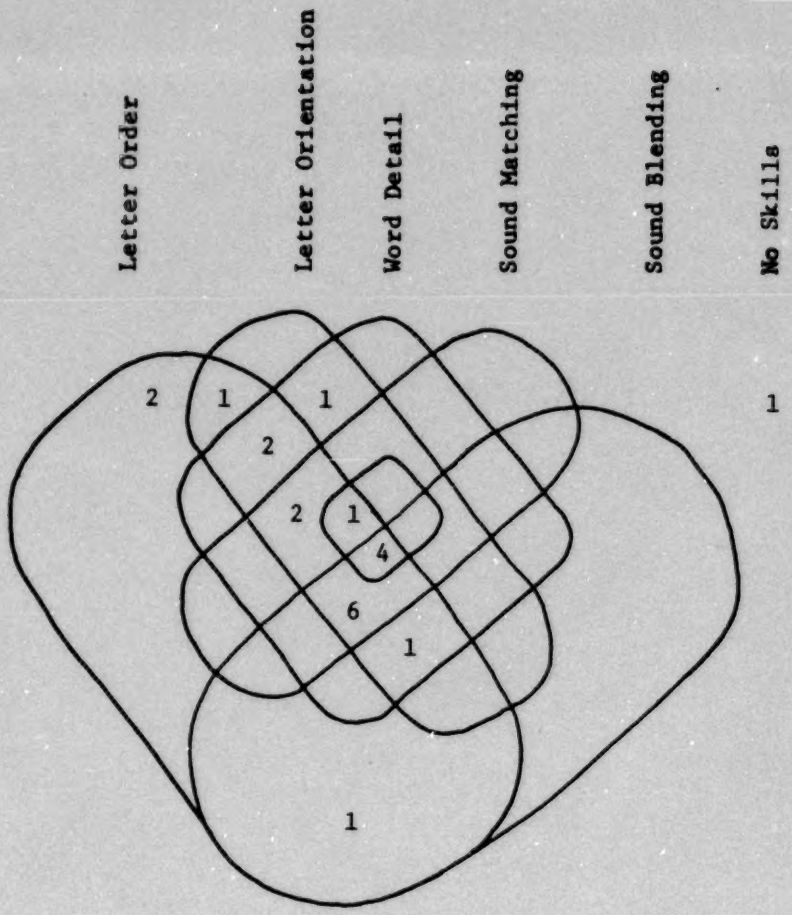
(Note: The small region in the center is to be taken as "outside" of the Word Detail region.)

Figure 12. The number of children mastering each combination of prereading skills--fall 1972, Control group.



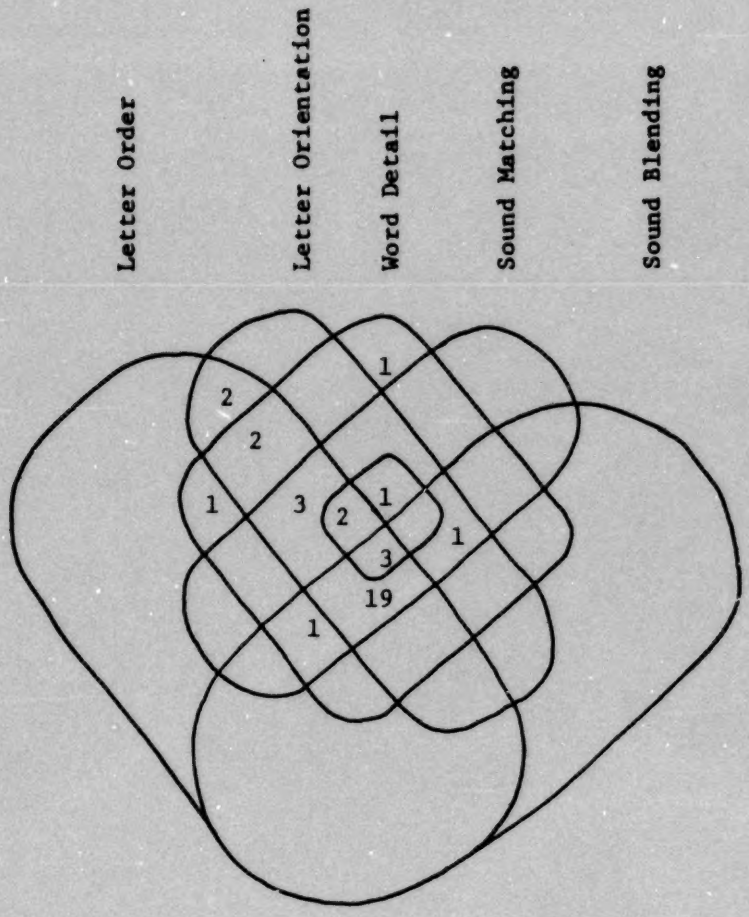
(Note: The small region in the center is to be taken as "outside" of the Word Detail region.)

Figure 13. The number of children mastering each combination of prereading skills--winter 1972-73, Control group.



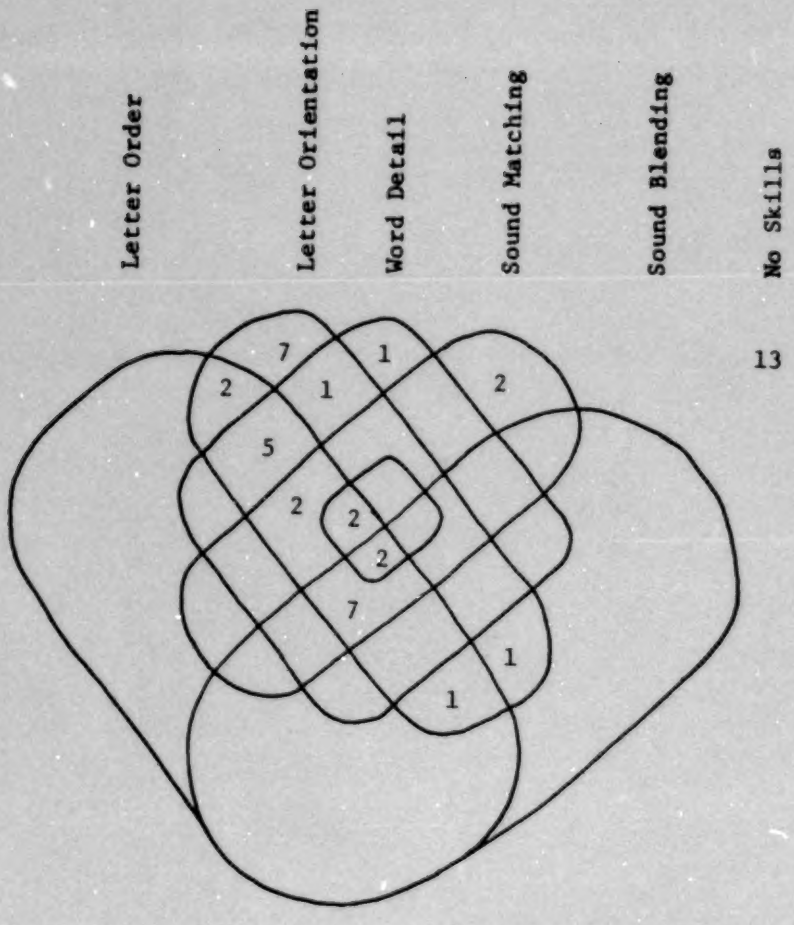
(Note: The small region in the center is to be taken as "outside" of the Word Detail region.)

Figure 14. The number of children mastering each combination of prereading skills--spring 1973, Program I group.



(Note: The small region in the center is to be taken as "outside" of the Word Detail region.)

Figure 15. The number of children mastering each combination of prereading skills--spring 1973, Program II group.



(Note: The small region in the center is to be taken as "outside" of the Word Detail region.)

Figure 16. The number of children mastering each combination of prereading skills--spring 1973, Control group.

TABLE 3

Percentages (Number) of Children in Entire Sample and in Subsamples Mastering Skills in Fall 1972

		Letter Order	Letter Orientation	Word Detail	Sound Matching
Program I	Sample* (N = 28)	4 (1)	11 (3)	7 (2)	4 (1)
Program I	Subsample** (N = 22)	5 (1)	14 (3)	9 (2)	5 (1)
Program II	Sample (N = 48)	17 (8)	38 (18)	10 (5)	8 (4)
Program II	Subsample (N = 36)	17 (6)	42 (15)	8 (3)	6 (2)
Control	Sample (N = 56)	11 (6)	20 (11)	7 (4)	11 (6)
Control	Subsample (N = 46)	13 (6)	24 (11)	9 (4)	13 (6)

*Sample selected at the beginning of the school year.

**Subsample of * which received all tests as scheduled.

Analysis of covariance procedures were used to make the comparisons. Regression analysis was used on the fall 1972 and spring 1973 scores to generate a predicted spring 1973 score for each child. Since the fall 1972 testing did not include data for sound blending, the generated data consisted of predicted scores for the other four skills and a predicted score for the number of skills mastered. These predicted scores were used in an analysis of variance to look for differences between the means of the groups. These analyses, reported in Tables 4-8, indicate in each case differences among the means that are significant for $\alpha = .01$.

A Scheffé procedure was used to test the statistical significance of contrasting the mean of the PRS users against the nonusers. In each of these five tests, the contrast, also at $\alpha = .01$, was statistically significant. The confidence intervals for these contrasts are reported in Table 9.

TABLE 4

Analysis of Variance Table for Estimated Scores for Letter Order

Source	DF	SS	MS	F
Regression due to group effect	2	217.7000	108.9000	16.5919
Regression due to sex	1	0.3693	0.3693	0.0563
Regression due to interaction	2	22.9400	11.4700	1.7483
Regression	6	356.1000	59.3500	9.0466
Error	97	636.4000	6.5600	
Total	103	992.5000	65.9100	

For $\alpha = .01$, $F(2,97) = 4.83$
$F(1,97) = 6.91$

TABLE 5

Analysis of Variance Table for Estimated Scores for Letter Orientation

Source	DF	SS	MS	F
Regression due to group effect	2	42.32	21.160	7.1787
Regression due to sex	1	1.013	1.013	0.3438
Regression due to interaction	2	29.890	14.940	5.0705
Regression	6	107.000	17.840	6.0518
Error	97	285.900	2.947	
Total	103	392.9	20.78	

For $\alpha = .01$, $f(2,97) = 4.83$
$F(1,97) = 6.91$

TABLE 6

Analysis of Variance Table for Estimated Scores for Word Detail

Source	DF	SS	MS	F
Regression due to group effect	2	97.490	48.740	11.0576
Regression due to sex	1	1.072	1.072	.2433
Regression due to interaction	2	16.370	8.186	1.8570
Regression	6	287.200	47.870	10.8605
Error	97	427.600	4.408	
Total	103	714.800	52.280	

For $\alpha = .01$, $F(2,97) = 4.83$
$F(1,97) = 6.91$

TABLE 7

Analysis of Variance Table for Estimated Scores for Sound Matching

Source	DF	SS	MS	F
Regression due to group effect	2	215.50000	107.70000	16.2027
Regression due to sex	1	0.04731	0.04731	0.0071
Regression due to interaction	2	5.36600	2.68300	0.4035
Regression	6	537.40000	89.57000	13.4692
Error	97	645.00000	6.65000	
Total	103	1182.00000	96.220000	

For $\alpha = .01$, $F(2,97) = 4.83$
$F(1,97) = 6.91$

TABLE 8

Analysis of Variance Table for Estimated Scores for Number of Skills Mastered

Source	DF	SS	MS	F
Regression due to group effect	2	55.4900	27.7400	23.5687
Regression due to sex	1	0.2235	0.2235	0.1898
Regression due to interaction	2	1.1260	0.5630	0.4783
Regression	6	103.0000	17.1700	14.5882
Error	97	114.2000	1.1770	
Total	103	217.2000	18.3500	

For $\alpha = .01$, $F(2,97) = 4.83$
$F(1,97) = 6.91$

TABLE 9

Means and Standard Deviations of Estimated Dependent Variables and Confidence Intervals for Differences Between the Mean of Program I and Program II Against the Mean of the Control

	Program I		Program II		Control		Upper Limit of C.I.*	Lower Limit of C.I.*
	Mean	SD	Mean	SD	Mean	SD		
Letter Order	14.82	1.003	15.16	1.136	12.17	1.320	9.01	2.63
Letter Orientation	15.14	0.4160	15.47	0.573	13.94	0.935	4.73	.43
Word Detail	13.41	1.3590	14.56	1.020	11.93	1.239	6.34	1.10
Sound Matching	13.64	1.4740	14.42	1.511	11.07	1.909	9.02	2.60
Number of Masteries	2.86	0.4110	3.44	0.668	1.79	0.768	4.18	1.48

*$\alpha = .01$

To summarize the comparison of PRS users and nonusers, regression analysis was used to estimate achievement scores that took into account initial differences between the Program I, Program II, and Control groups. An analysis of variance on these predicted scores showed that the group means were different; a post hoc Scheffé contrast indicated that scores of users were significantly greater than scores of nonusers.

With this statistically significant contrast, the means of the estimated dependent variables (reported in Table 9) can be interpreted. On parts of the skills test, the means for PRS users are very high; mastery level is reached in six of the eight cells, while the other two (word detail and sound matching for Program I) are close to mastery level. Corresponding means for the Control group are also fairly high, with one--letter orientation--almost reaching mastery level. These high scores for both PRS users and nonusers, along with the result that the differences between the users and nonusers are statistically significant, may indicate that one effect of PRS is to raise the achievement level of children who would not develop the prereading skills on their own.

Another effect of PRS is suggested by the other contrast, that of the number of skills mastered. On this criterion, the nonuser group mean was less than two skills mastered (out of the four skills that were considered), while the mean for the users was over three skills mastered. Developing several of the prereading skills seems to be an important effect of using the Pre-reading Skills Program.

A second approach to the assessment of PRS effects on skill development was based on scores on a standardized reading readiness test. Four subtests of the Clymer-Barrett Prereading Battery, Form A, including visual and sound matching activities and upper- and lower-case alphabet recognition were selected: Recognition of Letters; Matching Words; Discrimination of Beginning Sounds in Words; and Discrimination of Ending Sounds in Words. The four subtests were given to all children in the participating kindergarten classes in spring 1973.

Two trends in the results were anticipated. Since letter naming is not a part of the Pre-reading Skills Program, but is a standard part of most kindergarten curricula, it was predicted that scores for PRS users would be lower than scores for children in the Control group. On the other hand, since visual and sound matching activities are emphasized in PRS, it was predicted that scores for PRS users would be higher than scores for nonusers on the other three subtests.

Taking the mean scores on the four parts of the prereading test that had been given in the beginning of kindergarten (Table 2) and comparing them by analysis of variance revealed that the groups were not initially equivalent; the Program II group entered significantly higher than the Control group, and the Control group scores were significantly better than the Program I group ($\alpha = .01$). With this result, it was decided that contrasting the spring 1973 Clymer-Barrett scores of the Program I and Control groups would give a useful but conservative comparison between PRS users and nonusers.

The mean scores for the Program I ($N = 154$) and Control ($N = 262$) groups on each of the four Clymer-Barrett subtests are shown in Table 10. The two anticipated trends are apparent; on the subtests for letter recognition, the

TABLE 10

Group Means on Clymer-Barrett Subtests

	Program I (N = 154)	Control (N = 262)
Recognition of Letters (Max. = 35)	27.28	29.12
Matching Words (Max. = 20)	15.75	13.90
Discrimination of Beginning Sounds in Words (Max. = 20)	15.94	13.40
Discrimination of Ending Sounds in Words (Max. = 20)	15.27	13.49

Control group mean was higher than the Program I group mean, while on word matching, beginning sounds, and ending sounds, the Program I group was superior. An analysis of variance on these data, reported in Table 11, shows that these differences are statistically significant. These results indicate that the designed effects of PRS show up on a standardized instrument for assessing reading readiness.

RESULTS II--SKILL RETENTION

The data gathered in spring 1973 and fall 1973 on the Program I, Program II, and Control samples were used to investigate retention of mastery or nonmastery status of children during the summer between kindergarten and first grade. An immediate question, due to the extensive attrition between the two testing periods (see Table 1), deals with whether or not the fall 1973 samples are similar to the 1972-73 samples. The procedure used to ascertain the degree of similarity is the same as the one used earlier, that is, identifying within each group a subgroup of the children tested in spring 1973, that subgroup composed of the children who were available for testing

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TABLE 11

Analysis of Variance Table Comparing Program I and Control Groups on Subtests of Clymer-Barrett Battery (Subtests are Considered to be Independent)

Source	DF	MS	F
Recognition of Letters	1	329.40	4.55
Error	414	72.42	
Matching Words	1	334.20	10.76
Error	414	31.05	
Beginning Sounds	1	624.80	22.12
Error	414	28.25	
Ending Sounds	1	305.20	12.47
Error	414	24.47	

For $\alpha = .01$, $F(1,414) = 6.70$
For $\alpha = .05$, $F(1,414) = 3.86$

in fall 1973. A comparison of the spring 1973 percentages of each subgroup with the spring 1973 percentages of the corresponding entire group would then show whether the children available for testing in fall 1973 adequately represented the original groups. These percentages are presented in Table 12. In 12 of the 15 comparisons, the difference is 8 percent or less and the remaining three cases do not differ by more than 15 percent. These very small differences suggest that the fall 1973 subsamples adequately represented the original samples.

One of the general questions regarding retention is whether or not there are differences between users and nonusers of PRS. If there are differences, this could indicate that the way a child acquires a skill affects its retention. Percentages of children who retained their mastery or nonmastery status between the spring 1973 and fall 1973 testing are presented in Tables 13 and 14.

The triples of mastery retention percentages (Table 13) are very similar for each skill and differences between the two program groups seem equivalent to differences between either program group and the Control group. The three visual skills especially show almost identical percentages.

TABLE 12

Percentages of Children in Entire Sample
and in Subsample Mastering Skills in Spring 1973

		Letter Order	Letter Orientation	Word Detail	Sound Matching	Sound Blending
Program I	Sample (N = 22)	91	82	55	59	55
Program I	Subsample (N = 15)	87	80	47	67	53
Program II	Sample (N = 36)	94	94	81	86	67
Program II	Subsample (N = 27)	93	93	70	81	59
Control	Sample (N = 46)	44	64	33	31	24
Control	Subsample (N = 26)	58	69	35	46	31

In the nonmastery retention percentages (Table 14), the three groups are very similar on the two sound skills. Some of the dissimilarities on the visual skills, especially letter order, may result from the small number of children who were nonmasters in spring 1973.

In conclusion, there do not appear to be large differences in retention across the three groups. Thus, mastery or nonmastery retention for a child between the end of kindergarten and the beginning of first grade does not seem related to whether or not the child used PRS during kindergarten.

The retention data were also analyzed to show percentages of groups that changed their master' and nonmastery classifications between grades. These percentages indicate the reliability of the Prereading Skills Test, if given at the end of kindergarten, as a source of relevant information for instructional decisions at the beginning of first grade.

The percentages of children who changed their classification are presented in Table 15. (Since the previous analyses did not indicate differences between the three groups, the groups were pooled in Table 15.) The portion of the group

TABLE 13

Retention of Mastery Scores from Spring 1973 to Fall 1973

	Number of Children at Mastery (Spring 1973)	Percentage (Number) Retaining Mastery (Fall 1973)	Number Changing to Nonmastery (and Nonmastery Scores) (Fall 1973)
Letter Order			
Program I (N = 15)	13	85 (11)	2(9,11)
Program II (N = 27)	25	84 (21)	4(10,12,13,13)
Control (N = 26)	15	87 (13)	2(9,13)
Letter Orientation			
Program I	12	100 (12)	0
Program II	25	100 (25)	0
Control	18	94 (17)	1(13)
Word Detail			
Program I	7	86 (6)	1(12)
Program II	19	89 (17)	2(11,12)
Control	9	89 (8)	1(10)
Sound Matching			
Program I	10	80 (8)	2(12,13)
Program II	22	86 (19)	3(9,9,12)
Control	12	75 (9)	3(13,13,13)
Sound Blending			
Program I	8	75 (6)	2(10,13)
Program II	16	88 (14)	2(12,13)
Control	8	88 (7)	1(9)

TABLE 14

Retention of Nonmastery Scores from Spring 1973 to Fall 1973

	Number of Children at Nonmastery (Spring 1973)	Percentage (Number) Retaining Nonmastery (Fall 1973)	Number Changing to Mastery (and Nonmastery Scores) (Fall 1973)
Letter Order			
Program I (N = 15)	2	50 (1)	1(12)
Program II (N = 27)	2	50 (1)	1(13)
Control (N = 26)	11	91 (10)	1(8)
Letter Orientation			
Program I	3	100 (3)	0
Program II	2	50 (1)	1(13)
Control	8	75 (6)	2(10,13)
Word Detail			
Program I	8	75 (6)	2(11,13)
Program II	8	25 (2)	6(10,11,11,12,13,13)
Control	17	53 (9)	8(6,9,9,11,12,12,13,13)
Sound Matching			
Program I	5	80 (4)	1(12)
Program II	5	100 (5)	0
Control	14	79 (11)	3(9,9,13)
Sound Blending			
Program I	7	71 (5)	2(12,13)
Program II	11	73 (8)	3(9,12,13)
Control	18	78 (14)	4(11,12,12,13)

that changed classification ranges from 6 percent for letter orientation to 29 percent for word detail. There was no clear preference for direction of changes; for two skills (letter order and sound matching) changes to nonmastery prevailed over changes to mastery, while for the other three skills a larger percentage changed to mastery than to nonmastery.

TABLE 15

Percentages of Children Who Do and Who Do Not Retain Levels of Mastery and Nonmastery (Spring 1973/Fall 1973)

	Mastery/ Mastery	Nonmastery/ Nonmastery	Percentage Retaining Status	Mastery/ Nonmastery	Nonmastery/ Mastery	Percentage Changing Status
Letter Order	66	18	84	12	4	16
Letter Orientation	79	15	94	2	4	6
Word Detail	46	25	71	6	23	29
Sound Matching	53	29	82	12	6	18
Sound Blending	40	40	80	7	13	20

Another point about the reliability of the Prereading Skills Test can be observed in Tables 13 and 14. Thirty-five children changed classification from nonmastery to mastery and 26 changed from mastery to nonmastery. In both groups, more than one-third of the children had a nonmastery score of 13, while approximately another one-fourth of each group had a nonmastery score of 12. This suggests that the reliability of the test for making first grade instructional decisions based on kindergarten data is largely associated with the

reliability of the test for assessing mastery for an individual child and perhaps not so much with children's learning or forgetting of prereading skills.

RESULTS III--FIRST GRADE MASTERY

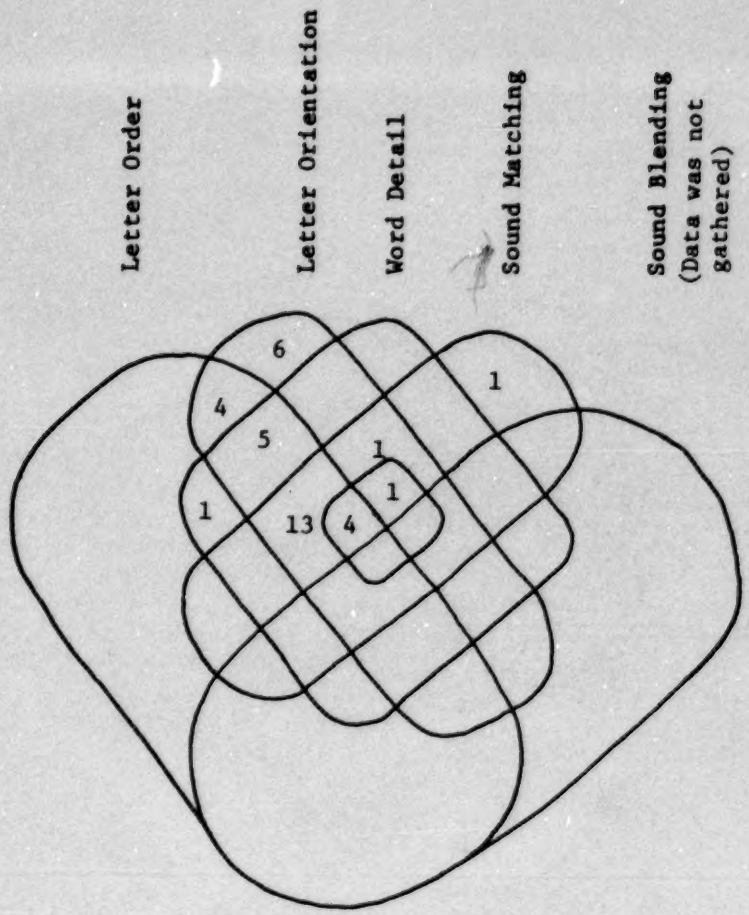
The first grade sample, comprised of children who did not use PRS, showed fall 1972 percentages of mastery on the four skills assessed that are uniformly half again as great as those of the kindergarten Control sample in spring 1973 (Table 16). The spring 1973 first grade data show extremely high percentages of mastery: over 90 percent on letter order, letter orientation, word detail, and sound blending, and only slightly lower (84 percent) on sound matching. The mastery combinations are shown in Figures 17 and 18. These data demonstrate that children who enter their first year of reading instruction without certain prereading skills generally acquire them by the end of the year. Since the mastery percentages were so high in the spring (an average of 98 percent for visual skills and 88 percent for sound skills), no attempt was made to relate skill mastery to reading ability. Furthermore, no data were obtained on the difficulties that children who entered the year without specific prereading skills had in learning to read. The present data, therefore, are a weak test of the effect of prereading skills on learning to read. If, for example, many children who were reading adequately at the end of the year showed low prereading skill mastery, then the necessity of the selected skills for learning to read would be highly suspect.

TABLE 16

Percentages of First Grade Children
Mastering Each Skill
(N = 37)

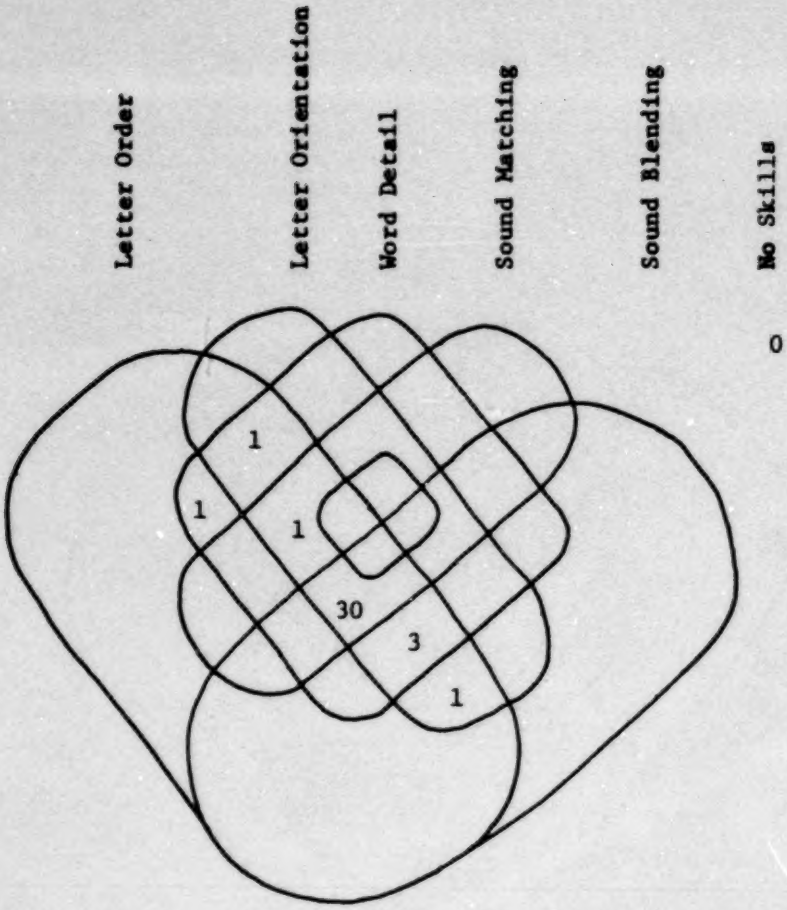
	Letter Order	Letter Orientation	Word Detail	Sound Matching	Sound Blending
Fall 1972	68	85	50	50	*
Spring 1973	100	97	97	84	92

*Sound blending was not tested in the fall.



(Note: The small region in the center is to be taken as "outside" of the Word Detail region.)

Figure 17. The number of children mastering each combination of prereading skills--fall 1972, Grade 1 group.



(Note: The small region in the center is to be taken as "outside" of the Word Detail region.)

Figure 18. The number of children mastering each combination of prereading skills--spring 1973, Grade 1 group.

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CONCLUSIONS

The major conclusions which can be drawn from this study are that (1) many children who enter kindergarten without certain prereading skills do not acquire these skills without overt instruction in them; (2) the use of PRS ensures a high percentage of skill mastery by children who need instruction in prereading skills; and (3) no matter how these skills are obtained by the end of kindergarten, they tend not to be lost by the beginning of first grade. On the question of the necessity of these skills for learning to read, these studies show only that children who have had a year of reading instruction also show a high level of prereading skill mastery. Further studies are required to show any more definitive relationship between prereading skills and learning to read.

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